

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of)	
)	
Amendment of the Commission's Rules)	ET Docket No. 98-237
With Regard to the 3650-3700 MHz)	RM-9411
Government Transfer Band)	
)	
The 4.9 GHz Band Transferred from)	WT Docket No. 00-32
Federal Government Use)	

To : The Commission

REPLY COMMENTS OF BeamReach Networks Inc.

BeamReach Networks Inc. ("BeamReach") hereby responds to Comments submitted in the above referenced First Report and Order and Second Notice of Proposed Rulemaking (FR&O & 2nd NPRM) for the 3650-3700 MHz frequency band. These comments augment the Record in respect of the capability of Adaptive Multibeam OFDM wireless technology to provide high capacity and high coverage Broadband Wireless Access services within the bands concerned using advanced Time Division Duplex (TDD) and frequency block / sub-banding allocations.

1. INTRODUCTION

BeamReach Networks Inc (formerly Radix Wireless Inc) was formed in February 2000 to exploit a new form of Adaptive Multibeam OFDM wireless technology in order to develop a new generation of high capacity, high efficiency, high coverage Broadband Wireless Access (BWA) systems for licensed frequency bands below 5GHz. The first systems will be delivered to trial customers in the North American WCS and MDS frequency bands during 2001 for volume commercial deployments starting early in 2002. This technology would also be adaptable to the UHF, PCS and 3650 MHz bands, subject to appropriate service provider interest and commercial justifications.

In its comments¹ Transcomm used BeamReach as an example of the payload capacity achievable in “restricted” bands such as 3650-3700 MHz and made recommendations regarding the licensing of these bands for TDD and high efficiency technologies. In these Reply Comments BeamReach is pleased to confirm the figures quoted by Transcomm in its example and endorses the relevant recommendations of Transcomm regarding TDD operation and licensing based on 12.5 MHz single or paired block sizes. We are therefore pleased to augment the Record by submitting a brief description of the BeamReach technology in relation to the recommended licensing regime.

2. THE ADAPTIVE MULTIBEAM OFDM ADVANTAGE

This technology uses advanced adaptive beamforming techniques to provide discrete “spot” beams from a base station to individual subscriber units. These beams are maintained only for the short durations needed to transfer data packets to or from the subscriber unit and are then released for use by other subscribers. Depending on the deployment scenario, each Base Station can simultaneously re-use the same set of frequencies 10 – 16 times **within** the same cell . In addition, adjacent cells can also simultaneously use the same set of frequencies to serve their subscribers units (N=1 frequency reuse). This gives a deployed payload spectrum utilization efficiency of 10-16 bits per second per Hertz per cell (bps/Hz/cell) which is more than TEN times that achieved by conventional TDMA, CDMA or OFDM schemes.

This capacity / efficiency advantage yields much higher payloads per base station which significantly reduces the deployment costs for business and urban applications, or conversely improves the economic feasibility of using smaller frequency allocations than conventional technologies, as described in the table below which is reproduced from the Transcomm comments.

¹ RM-9411 FR&O & 2nd NPRM : Comments of Transcomm Inc

<u>Band Allocation</u> (Paired or Contiguous)	<u>Downlink Payload per Cell</u> (Base Station to Customer)	<u>Uplink Payload per Cell</u> (Customer to Base Station)
6.25 + 6.25 = 12.5 MHz	Supercell : 100 Mb/s Multi-cell : 60 - 75 Mb/s	Supercell : 80 Mb/s Multi-cell : 50 - 60 Mb/s
12.5 + 12.5 = 25 MHz	Supercell : 200 Mb/s Multi-cell : 125 - 145 Mb/s	Supercell : 160 Mb/s Multi-cell : 100 - 120 Mb/s
25 + 25 = 50 MHz	Supercell : 400 Mb/s Multi-cell : 250 - 295 Mb/s	Supercell : 320 Mb/s Multi-cell : 200 - 240 Mb/s

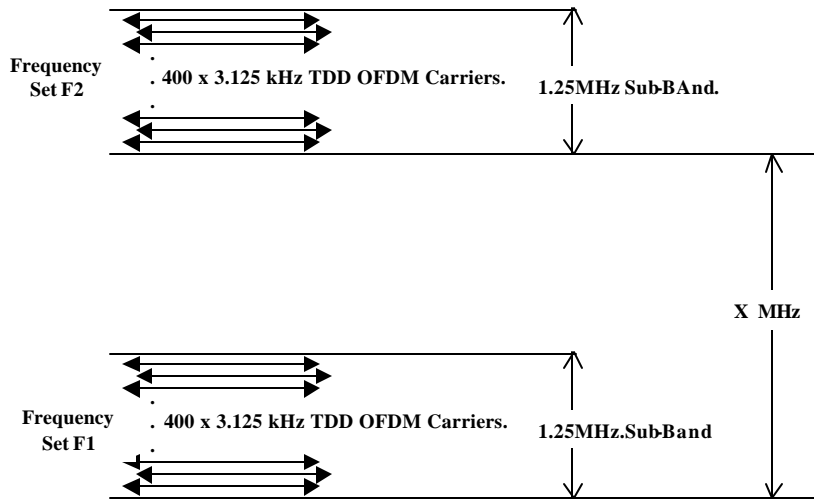
Typically, a (100 + 80) Mb/s payload capacity can serve up to 12,500 residential data customers, 17,500 residential voice lines, 5000 small business data customers, 7,500 business voice lines or appropriate aggregations within these values.

Adaptive Multibeam OFDM technology typically yields a 10dB improvement in overall link budget compared to conventional technologies, and a further 10dB improvement in fade margins. This means that BWA service can be provided to residential, small and medium business customers on a **non-Line-of-Sight** basis with 99.999% link availability and superior coverage – providing a 2 – 3 times improvement in cell radius, or 4 – 9 times increase in coverage area per base station, with consequent financial savings for the service providers, especially in residential, suburban, rural, low penetration or low penetration overlay applications.

3. THE BEAMREACH RADIO LINK

Each subscriber unit receives one or more pairs of frequency sub-bands from the base station (depending on its dynamic payload requirements) for the duration needed to transfer the appropriate data packets. Figure 1 below shows a basic (1.25 + 1.25) MHz “Sub- Band Pair” (SBP) link that delivers 1.5 Mb/s payload in the downlink direction (base station to subscriber) plus 1.2 Mb/s payload in the uplink direction (subscriber to base station). Payloads less than these rates would be supported using a proportion of the capacity of the sub-band pair by dynamically assigning packets and/or tone subsets accordingly. Being TDD, other payload asymmetry ratios can be configured if required, without affecting the frequency plans.

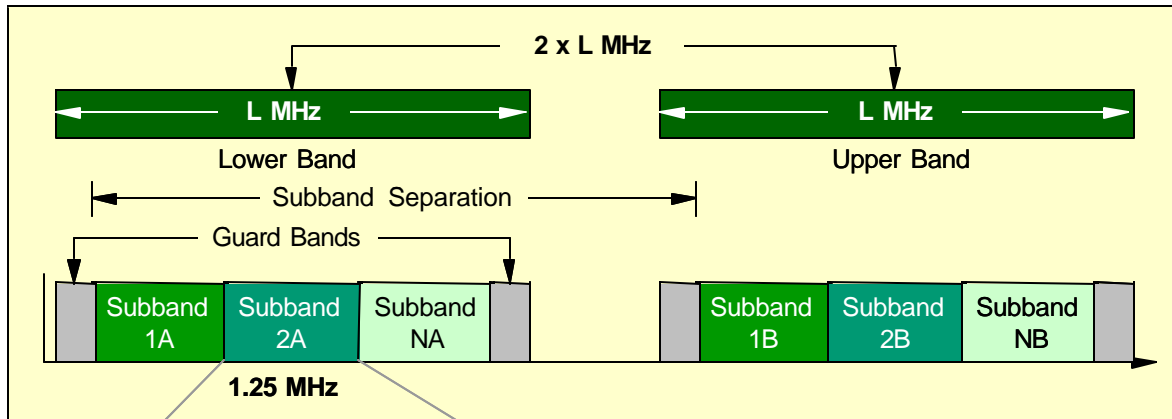
Figure 1 : BeamReach Basic Sub-Band Pair (SBP)



The payload packets are coded across the 800 discrete OFDM tones in two logical frequency groupings (1.25 MHz sub-bands F1 and F2). This provides frequency diversity for improved link availability and multipath immunity (over and above that provided by OFDM itself) and is also used to enable the unique “spot” beam-forming capability, in conjunction with adaptive antenna arrays at the base station. The frequency separation (X) between the sub-bands F1 and F2 needs to be sufficient to assure these improvements, with a minimum value of 3 - 5 MHz. Typical deployments would utilize more than one sub-band pair, stacked one above the other with a correspondingly larger separation X. Where spectrum is licensed in paired blocks (e.g. for conventional FDD schemes) then the separation X is dictated by the paired licensing allocation

Where individual sub-bands occupy either edge of the licensed allocation then an appropriate guard band is included (typically 500 – 800kHz) to ensure compliance with out-of-band emission limits into the adjacent bands. Where the licensed allocation is non-contiguous (e.g. certain MDS or WCS band scenarios) then the BeamReach sub-bands can be programmed to use the available (fragmented) channels as if they were contiguous, subject to the inclusion of additional / appropriate guard bands as noted above. Figure 2 below shows how the BeamReach sub-band pairs can be configured in a typical paired-band licensing arrangement (similar to FDD).

Figure 2 : Typical Frequency Plan



Note that for contiguous allocations, the middle guard bands and unused frequencies are NOT required, the upper and lower sub-bands can operate directly adjacent to each other.

Thus :

- a $5 + 5$ or 10 MHz allocation can support up to three sub-band pairs,
- a $6.25 + 6.25$ or 12.5 MHz allocation can support up to four sub-band pairs,
- a $10 + 10$ or 20 MHz allocation can support up to seven sub-band pairs,
- a $12.5 + 12.5$ or 25 MHz allocation can support up to eight sub-band pairs, and so on.

4. SUMMARY

- a) Adaptive Multibeam OFDM wireless technology provides the spectrum utilization efficiency necessary to enable economically viable broadband wireless access deployments in restricted frequency bands
- b) Adaptive Multibeam OFDM wireless technology can operate efficiently in paired, single or fragmented licensing band structures, with no need for the wide separation gaps needed for conventional FDD technologies.
- c) The use of TDD protocols within the air-link architecture support more flexible and more cost effective customer premise equipment solutions.
- d) In addition to the acknowledged advantages of TDD, these technologies can also coexist successfully with FDD systems in adjacent cells or bands where applicable.
- e) Adaptive Multibeam OFDM wireless technology provides the superior coverage necessary to support residential and small business non-line of sight and simple / cheap installation processes, as well as the higher capacity and reliability characteristics necessary to support medium and more symmetrical business applications.

BeamReach Networks Inc would be pleased to present additional technical and deployment information to assist the Commission in its 3650-3700 MHz rulemaking process.

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